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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/072,907	02/12/2002	Soo Seok Choi	1567.1022	3556

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EXAMINER	
ALEJANDRO, RAYMOND	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 01/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/072,907	CHOI ET AL.	
	Examiner	Art Unit	
	Raymond Alejandro	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 October 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-17 and 29-39* is/are pending in the application.

4a) Of the above claim(s) *29-37* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17 and 38-39* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 February 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/22/04 has been entered.

This office submission is in reply to the foregoing RCE and its related amendment. The applicants have overcome the objections and the 35 USC 103 rejection. Refer to the abovementioned amendment for specific details on applicant's rebuttal arguments. However, the present claims are rejected over new art as set forth hereinbelow and for the reasons of record:

Election/Restrictions

1. This application *still* contains claims 29-37 drawn to an invention nonelected with traverse in the reply filed on 01/06/04. A complete reply to the rejection must include cancelation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1-4, 8-17 and 38-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu 5523179 in view of the Japanese publication JP 47-028431 (herein called "*the JP'431 publication*").

The present claims are drawn to a lithium-sulfur battery wherein the disclosed inventive concept comprises the specific positive active material.

As to claims 1-3:

Chu discloses battery cells comprising a sulfur-based positive composite electrode wherein the active sulfur is elemental sulfur or sulfur containing discharge products of elemental sulfur; a negative electrode comprises lithium metal such as lithium metal or lithium-aluminum alloys (ABSTRACT/CLAIM 1/ CLAIM 9). It is disclosed that the positive electrode comprises an electronically conductive material and an ionically conductive material (COL 5, lines 1-9). The electrolyte separator is also taught (CLAIM 1). It is disclosed that the electrolyte separator for solid state batteries functions as a separator for the positive and the negative electrodes, and as a transport medium for the metal ions (COL 11, lines 9-15). It is also disclosed that for battery cells containing a liquid electrolyte such battery format contains a separator within the liquid

electrolyte (COL 11, lines 35-42). *Thus, the battery cell has a separator and an ion-conducting electrolyte.*

As to claims 4, 8, 10-14, and 16:

Chu teaches the use of elemental sulfur per se and conductive material (COL 4, lines 27-35/ COL 5, lines 1-15); it is disclosed that the term "active sulfur is defined to be elemental sulfur or sulfur that would be elemental if the positive electrode were in its theoretical fully charged state (COL 8, lines 32-35); it may also comprise binders (COL 5, lines 25-28). This composition is intermixed (COL 5, lines 1-8); it's dispersed in a composite matrix by being mixed (COL 8, line 45 to COL 10, line 10). It is disclosed that the positive electrode slurry is cast directly onto a SS current collector (COL 10, lines 58-65).

Furthermore, as to the method limitation, i.e. i) mixing (ball mill), ii) coating, iii) removing, iv) injecting, v) employment of a plasticizer and its removing solvent and the likes, it is further noted that a method limitation incorporated into a product claim does not patentable distinguish the product because what is given patentably consideration is the product itself and not the manner in which the product was made. Therefore, the patentability of a product is independent of how it was made. In this regard, it is thus noted that since the plasticizer is removed from the positive electrode, the plasticizer and the removing solvent are not an active constituent of said positive electrode. That is, the plasticizer and the removing solvent were just employed as part of the preparation technique but the plasticizer was removed thereafter by using the solvent. Further, since the porosity of the positive electrode as claimed also includes "0 (zero) porosity" or "a pore-free material", it is hence asserted that no plasticizer and removing solvent is required.

As to claim 9:

Chu discloses the presence of polysulfide form material (COL 4, lines 30-36/ COL 4, lines 60-65).

As to claim 15:

Chu discloses the use of, at least, polyethylene oxide (COL 10, lines 46-55/ COL 9, lines 45-60/ COL 5, lines 9-15).

As to claim 17:

Chu discloses the ionic conductor in the positive electrode can be any of the solid-state or gel-state electrolytes described in the electrolyte separators and liquid electrolyte sections (COL 10, lines 23-27) as well as any electronically insulating and ionically conductive material which is electrochemically stable may be used (COL 10, lines 46-55/ COL 9, lines 45-60/ COL 5, lines 9-15). In particular, Chu teaches the following organic liquids of the battery cell incorporating the positive electrode: propylene carbonate; ethylene carbonate, N-methylpyrrolidinone, butyrolactone, tetramethylurea and the likes (COL 11, lines 26-35).

As to claims 38:

Chu teaches the employment of solid electrolytes (Col 11, lines 8-15/ COL 5, lines 62-67/ Col 10, lines 23-27).

As to claim 39:

Chu teaches the use of polymeric, glass and/or ceramic materials are appropriate as solid-state electrolyte separators (Col 5, lines 62-67).

Chu et al disclose a lithium-sulfur battery comprising a sulfur-based positive composite electrode according to the foregoing aspects. However, Chu et al does not expressly disclose the specific pore size; and the pore size as recited in claim 3.

As to claims 1-3:

The JP'431 publication discloses a sodium-sulfur secondary battery with low voltage drop because of contact resistance wherein the battery comprises a cathode activator of a melted sulfur (ABSTRACT); the sulfur is an electric insulator so that it is necessary to increase conductivity of the sulphur to react electrochemically in the battery (ABSTRACT). It is disclosed that it is essential to use a porous conductor consisting of a material having a degree of porosity with pore diameters of 10-1000μm as a cathode member to increase the conductivity of the cathode (ABSTRACT).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to make Chu et al's positive active material including sulfur by having the specific pore size of the JP'431 publication because the JP'431 publication reveals that in battery system using sulfur it is essential to use a porous conductor consisting of a material having a degree of porosity with pore diameters of 10-1000μm as a cathode member to increase the conductivity of the cathode, that is to say, to increase conductivity of the sulphur to react electrochemically in the battery. Thus, it is emphatically contended that the JP'431 publication discloses such cathodes having the specific pore size are better conductor and can be used in electrochemical applications involving alkali-metal technology. Therefore, since the prior art directly teaches a sulfur containing cathode having a pore diameter of at least 10-15 μm, a prima-facie case of obviousness still exists. Applicants' attention is respectfully directed to ***MPEP***

2144.05 [R-1] Obviousness of Ranges where is stated that in the case where the claimed range lies inside or overlaps a range disclosed by the prior art a prima-facie case of obviousness exists. *In re Wertheim 191 USPQ 90*; or at least, is sufficient to establish a prima-facie case of obviousness. *In re Peterson 65 USPQ2d 1379*. Hence, the JP'431 publication directly teach the use of sulfur cathode materials having a pore size within the claimed range by positively stating that the pore diameter is critical to achieve the desired cathode conductivity. Furthermore, the JP'431 publication and Chu et al share the same field of endeavor as they both address and disclose alkali metal-sulfur based batteries and their related technologies.

As to the specific pore size as recited in claim 3, it would have been obvious to a skilled artisan at the time the invention was made to make Chu et al's positive active material by having the claimed pore size because even though the JP'431 publication does not overlap or lie inside the claimed pore diameter a prima facie case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are ***close enough*** that one skilled in the art would have expected them to have the same properties. *Titanium Metal Corp. of America v. Banner 227 USPQ 773*. Moreover, the normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine a satisfactory and optimum pore diameter.

5. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu 5523179 in view of the Japanese publication JP 47-028431 as applied to claim 4 above, and further in view of Kovalev et al 6652440.

Chu and the JP'431 publication are applied, argued and incorporated herein for the reasons above. However, the preceding prior art does not expressly disclose the specific particle size of the elemental sulfur.

Kovalev et al teach electroactive cathode materials for electrochemical cells (COL 1, lines 10-15) wherein the cathode materials comprise sulfur-sulfur bond such as elemental sulfur (COL 1, lines 43-50). It is disclosed that such cathode materials are useful in batteries employing alkali-metal anode, in particular, lithium or lithium-alloy anodes (COL 1, lines 35-53/COL 16, lines 64-67). It is further disclosed that in one embodiment, **the particle size of elemental sulfur is from 0.01 to 100 microns** (COL 5, lines 18-20/COL 12, lines 7-9). *It is noted that Kovalev et al's particle size range encompasses, at least, particle sizes up to 20 μm, or 10 μm or 5 μm.*

In light of these disclosures, it would have been obvious to one skilled in the art at the time the invention was made to use the specific particle size of the elemental sulfur of Kovalev et al in the lithium-sulfur battery of Chu-the JP'431 publication as Kovalev et al teach that elemental sulfur having the claimed particle size is useful for making positive electrode of lithium-sulfur batteries because this particular positive electrode material exhibits satisfactory specific capacity in combination with a lithium anode. As a consequence, lithium-sulfur batteries employing elemental sulfur having the claimed particle size as positive electrode achieves high energy capacity and rechargeability by the electrochemical cleavage via reduction and reformation via oxidation of the elemental sulfur. *Hence, Kovalev et al directly teach the use of elemental sulfur having a particle size within the claimed range.*

Response to Arguments

6. Applicant's arguments with respect to claims 1-17 and 38-39 have been considered but are moot in view of the new ground(s) of rejection.

7. Although not necessary due to the new ground of rejection, the examiner wishes to briefly address the following applicant's arguments:

a) since applicants have argued that "*the Examiner does not set forth evidence as to where this motivation existed in the prior art, and why the use of the pores, which are described without asserting any known benefit and are only described as being used in an Na/S, would be otherwise desirable for the use in Chu et al. As such, the Examiner's assertion appears to be that such pores can exist in the art, without evidence explaining why one of ordinary skill in the art would choose such a pore size at the time of the invention*", and therefore, the validity of the entire rejection over Chu-Ishida et al has been somehow questioned because "*Ishida et al appears to briefly summarize a range that includes pores...in an existing Japanese patent publication....and does not suggest that the pores or the pores in such a range would be useful in other cell technologies...*", the examiner has now presented a new ground of rejection based on the teachings of such Japanese publication (*i.e. the JP'431 publication*) which clearly discloses that it is essential to use a porous conductor [in sulphur containing cathodes and batteries] consisting of a material having a degree of porosity with pore diameters of 10-1000μm as a cathode member to increase the conductivity of the cathode. As a result, the examiner has verified that the prior art certainly imparts criticality to the pore diameter. Thus, applicants' arguments concerning that there is no indication that the pore sizes suggested in Ishida et al

solves a particular problem and/or assert any known benefit are totally weak, fragile and insubstantial.

b) With particular respect to applicants' arguments regarding the broad range (including both the pore diameter range and/or the broad particle size range of Kovalev et al), the examiner now categorically contends that the JP'431 publication positively discloses such cathodes having the specific pore size are better conductor (conductivity is increased) and can be used in electrochemical applications involving alkali-metal technology; in addition, it is also stated that Kovalev et al directly teach the use of elemental sulfur within the claimed particle size. Hence, since the prior art of record directly teaches a sulfur containing cathode having a pore diameter of at least 10-15 μm (*regardless the entire disclosed range from 10-1000 μm*) and elemental sulfur having a particle size ranging from 0.01-100 μm, a prima-facie case of obviousness still exists. Applicants' attention (**emphasis added**) is respectfully directed to ***MPEP 2144.05 [R-1] Obviousness of Ranges*** where is stated that in the case where the claimed range lies inside or overlaps a range disclosed by the prior art a prima-facie case of obviousness exists. *In re Wertheim 191 USPQ 90*; or at least, is sufficient to establish a prima-facie case of obviousness. *In re Peterson 65 USPQ2d 1379*. In particular, the JP'431 publication directly disclose the use of sulfur cathode materials having a pore size within the claimed range by positively stating that the pore diameter is critical to achieve the desired cathode conductivity; and Kovalev et al's particle size range encompasses the claimed one.

c) As to the specific pore size as recited in claim 3, it is stated that a prima facie case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are ***close enough*** that one skilled in the art would have expected them to have the same properties.

Titanium Metal Corp. of America v. Banner 227 USPQ 773. Moreover, the normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine a satisfactory and optimum pore diameter.

d) in the event that applicants further argue that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the JP'431 publication and Chu et al share the same field of endeavor and/or at least are pertinent to the particular problem with which the applicant was concerned as they both address and disclose alkali metal-sulfur based batteries and their related technologies.

e) as to the assertion that the prior art "*does not suggest advantage to any of these ranges as evident from Figures 4 and 5 and Tables 1 and 2 and paragraph 0023 and 0024*" and that "*applicant's range imparts a novel feature as compared to the general conditions suggested in the existing art*", it is noted that applicants' results show that the particular range is critical for a particle size of 5 μm only. For example, EXAMPLES 1-4 show the use of particle sizes of 5 μm only (SEE EXAMPLES 1-4). Further, Applicants are also comparing EXAMPLES 1-4 having a particle size of 5 μm with COMPARATIVE EXAMPLES 1-2 having particle sizes of 30 μm and 15 μm, respectively. Thus, as apparently admitted by the applicants, there is no unexpected result for the claimed range of particle sizes greater than about 15 μm. In addition, the results of Tables 1-2 of which applicants claim to show unexpected results are only commensurate with the

specific particle size of 5 μm. Hence, applicants have failed to provide objective evidence establishing the advantage of particle sizes throughout the entire claimed range (i.e. greater than or equal to 5 and less than and including 15 μm). Thus, it is considered that particle sizes immediately below about 5 μm and greater than 5 μm (*i.e. 0 <particle size (μm) <5 and 5 < particle size (μm) ≤15*) has no effect on the life cycle of the resulting battery. Therefore, since the prior art directly teaches particle sizes greater than 5 μm, a prima-facie case of obviousness still exists. Applicants' attention is respectfully directed to ***MPEP 2144.05 [R-1] Obviousness of Ranges*** where is stated that in the case where the claimed range lie inside a range disclosed by the prior art a prima-facie case of obviousness exists. *In re Wertheim 191 USPQ 90*; or at least, is sufficient to establish a prima-facie case of obviousness. *In re Peterson 65 USPQ2d 1379.*

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (571) 272-1282. The examiner can normally be reached on Monday-Thursday (8:00 am - 6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Raymond Alejandro
Examiner
Art Unit 1745